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NOTES ON THYRIDOPTERYX EPHEMERÆFORMIS HAWORTH.

BY PROF. WM. MACFARLAND.

It will be the object of this paper to present a few peculiarities in the habits of this insect which the writer has been privileged to observe. A few years ago, while walking through a cemetery, I observed an arbor vitæ which was nearly destitute of foliage. The cause was at once attributed to the basket worm, and upon further observation the accusation was truly confirmed. It seemed the tree had been literally alive with them, each limb bearing many cases, while the ground was strewn with empty ones.

When a boy I was frequently interested and amused by observing the monkey-like actions of these worms walking over the trees with their cases clinging to them, but had never given special attention to their life habits. It being winter when this tree was discovered, I little expected to begin the study of an insect which I knew lived only in summer, but a more opportune time could not have been possible as the following incidents will prove. Some of the cases were carried home for the purpose of making a microscopical examination of their structure, and more especially of the silk with which the case is lined. Not having time to attend to it at once, they were placed in a

closet in a warm room, when, in about three weeks after, the shelves on which they were placed seemed swarming with what were first taken for young spiders, owing to their agility and adroitness at spinning. But examined through a lens they were at once recognized by the odd turn of the abdomen, which points upward at an angle of about thirty degrees and so gives the worm an advantage in holding and carrying the case in after-life, and is not noticed except in the juvenile stage, when it is entirely unprotected.

The cases on the shelves were examined, but no eggs could be found. More cases were collected and examined, but with no better success. As almost every case contained the remains of a worm, I began examining the skins, when presently some white worms were discovered. They were alive, very fat and were taken for maggots of some species of dipteron. I continued dissecting the skins, and was finally rewarded for my labor by finding a plump skin filled with eggs, each so arranged in a packing of short silk fibre as not to touch the one next to it.

These eggs were removed, placed among cotton in a bottle, where they were hatched. For a few days the bottle presented a scene of great activity. The insects would climb as high as they could, spin a web and descend, and so continued their efforts to escape until starvation ended their antics.

With this success on my part the study of the insect was commenced and carefully watched through all its stages. Following its cycle, we must first admit that it is strangely ovoviviparous, and that the eggs remain in the ovaries of the dead female during winter. About the 1st of May the eggs are hatched, but the young remain in the ovary for several days, during which time I am of the opinion that they eat the silk fibre in which the eggs were packed. The silk lining of the case is also eaten by them, or cut into dust-like bits, as very little of it can be found after the young have escaped. At this juncture the means provided by the mother are exhausted, and each little individual makes his start in the world. The birds now con-

sume them in vast numbers, and the rains beat them to the earth, but in spite of these drawbacks many succeed in providing food, clothing and house before they reach maturity.

This house becomes the bride chamber and sepulcher of the mother, and the nursery of her children, who, after consuming her remains, including the shroud, abandon the homestead. The larva of this insect is an excellent climber, and moves more evenly than the larva of other lepidoptera.

The hind legs or hooks, which are intended for holding the case, are never used in creeping. The foundation of the case is made by appropriating the convex surface of a curled leaf, in the manner of a leaf-rolling insect. Enough of this leaf is used to form a cylindrical covering for the inhabitant. This rude structure is then cut from the leaf and carried off to be completed by many modifications and additions as the insect grows. The case is composed of vegetable fibre, collected from the tree and cemented with a silky secretion supplied by the worm. Thus, day by day, as the insect travels and feeds, it also collects building material.

By the middle of August the case is a marvel of completeness, being water-proof outside and silk-lined within. In shape it resembles a double cone, base to base. It is about one and a half inches long and covered with sticks arranged longitudinally, forming a *cheval-de-frise*. The bulge in the case seems provided for the accommodations of the worm in turning, as it comes out at either end at pleasure, both being open. When at rest and during bad weather, the case is temporarily suspended to any convenient object and loosened at the will of the occupant. The final hanging of the case, previous to metamorphosis, is of no little importance, however, and often causes the insect to travel great distances in order that a suitable situation may be found. The limb must be very small, so that the worm can hold the case suspended beneath while it spans the limb with the protruded part of its body, and thus carries the thread of silk

back and forth over it, attaching it to the case on each side, forming a complete loop.

That mysterious animal instinct which is so incomprehensible, teaches this worm of one summer carefully to avoid attaching its case to a treacherous leaf-stalk, which must fall before the approach of winter.

So persistently do these worms cling to their cases that the severest torture fails to unhouse them. The only means of turning the occupants out uninjured is by using a sharp knife, cutting the case from end to end. When thus treated the full-grown larva, seeming to realize the magnitude of the task, rarely attempts to build another, and soon perishes. The undeveloped larva, when deprived of a house, will immediately construct another. One worm can be thus induced to build several cases.

Since the larvæ are indiscriminate as to food, I am inclined to think that many trees are abandoned by them on account of the bluntness of their terminal branches, they being too large to serve the insect with winter quarters.

It will be noticed that when large trees are inhabited by them, only the small ends of the twigs become their winter habitat. The arbor vitæ, and small trees with many slender branches, are their favorite resorts, and when once attacked are frequently destroyed. After the basket is well constructed they have few enemies, but so persistent are these few that they nearly exterminate the basket worm. At least seventy-five per cent. are annually consumed by very small ichneumon flies. I have opened many cases and find that only about five per cent. contain ovaries filled with eggs.

An isolated worm usually escapes the ravages of the ichneumon, and so leaves eggs from which a new colony is formed. This colony will soon be overtaken and destroyed by the advancing hosts of ichneumon flies. I have recently visited localities which, less than two years ago, fairly swarmed with basket worms, and cannot now find a single case that shows recent construction. Neither can I find an old case among

hundreds examined which does not plainly show that their enemies totally consumed them. The balancing power of nature here plays a wonderful part in checking the increase of a noxious insect.

Many of the skins found during winter contain the larvæ of a small ichneumon fly with elbowed antennæ. In a warm temperature they will enter the pupa state and metamorphose in about twelve days. These are the worms previously mentioned, which were taken for the larvæ of a dipteron.

Most of the *T. ephemeræformis* thus infested with parasites are pupæ, but some are found in the imago state when the eggs have become the favorite food, and are wholly consumed. Occasionally a perfect female is found with the ovaries filled with silk for the protection of the eggs, which, from some cause, are not developed. In such an instance it seems safe to presume that she died a spinster. Before dying, however, this maiden carefully tucks herself away in her house, closes the doors and winds her silk wraps around her just as do the expectant mothers of her kind. The female spins silk during the imago state, which is almost a phenomenon.

The male carries his case during the larval state, hangs it up, passes the pupa stage in it, and then cuts his way out at the top, usually severing it from the limb, and escapes. He is now an unpretentious-looking moth or miller, and lives but a few days. To the farmer and gardener the value of an entomological investigation mainly depends upon the knowledge gained as to the modes of reproduction and distribution. With this object in view I have carefully studied this insect. With insects generally, the distribution of the species depends upon the placing of the eggs by the female. The female under consideration being a wingless moth and ovoviviparous, it would appear that its habits must be quite local. The eggs always remaining in her body, can go no farther than she carries them. The strength and endurance of the case, and the firmness with which it is attached to the tree, precludes the possibility of interference by

foreign agencies in aiding distribution. Then, since their habits are almost exclusively arboreal, it would seem that brood after brood would be produced on the same tree, which conclusion is partly correct. But nature provides a partial remedy for this wingless condition by developing the legs of the larva to an unusual length for a lepidopteron, and the distance the advanced larva of this species will sometimes travel is almost incredible. Isolated trees are frequently attacked by them. How they were reached, except by a half-mile walk on the part of the insect, cannot be explained.

There is but one brood annually, and from what has been observed, it is quite evident that all shrubs and trees may be ridded of these pests by picking the cases off during the winter or early spring.

The eggs are quite frail, and a gentle squeeze will crush them; hence pinching the cases may be the quickest remedy. If picking is resorted to, a pair of shears for cutting them loose will facilitate the operation.

BINOCULAR VISION OF LATERAL-EYED FISHES.

BY PROF. AUSTIN C. APGAR.

After a careful examination of the movement of the eyes of our common fresh-water fishes, I have come to the conclusion that the statement made in a number of works that the eyes of fishes are different from most other vertebrates, in that the two have separate fields of vision, is not true. If a line extending through the center of the pupil to the center of the retina were the actual axis of vision, then such lateral-eyed fishes as the fresh-water sun-fishes would have separate fields of vision; but I am convinced that the true axis extends through the anterior margin of the ovate pupil to the posterior side of the retina.

The spot of most distinct vision is this posterior portion of the retina, and on this spot the images formed in both eyes coincide.

When the fish is quietly swimming in the water this true axis is directed horizontally forward. This is true, whether the fish has its body horizontal or not. The movement of the eye-ball, to retain a horizontal direction of the true visual line, is a rotating one on the apparent optical axis; the rotation of the ball is not very noticeable, except in those fishes that have a dark band across the eye. One of those best marked for this purpose is the black-banded sun-fish (*Mesogonistius chætodon* (Baird) Gill. There are quite a number of species marked with distinctness enough to show the rotation well, and the movement is an interesting one to watch. When the body of the fish is almost perpendicular, the eye retains its natural horizontal direction; this is true, whether the fish is swimming obliquely upward or downward.

The medium in which fresh-water fishes live gives them a chance to see a great distance only in the horizontal direction, and the proper adjustment of the eye would make, under usual conditions, the optical axis take this direction. To me it seems impossible to explain the constant revolution of the eye-ball on any other hypothesis except that given, viz., that the optical axis extends forward instead of sidewise.

When a fish wishes to eat anything, either at the bottom of the pond or at the surface of the water, it swims directly towards the object; and in this case the eyes are instantly adjusted in line with the body, so as to bring the image of the particle desired upon the posterior portion of the retina. In this case they lose their usual horizontal position.

If a fish wishes to turn to the right or left in the water, the first movement is that of the eyes in unison in the direction of the turning. This would be entirely unnecessary if the apparent axis was the axis of most distinct vision, as one of the eyes would see all that was to be seen on the side of the turning After this movement of the eyes the body turns enough to bring

the eyes into their normal position, then there is again a movement of the eyes, and next a movement of the body. This causes a peculiar jerking motion of the eye-balls during the whole time of the turning of the body.

HOW THE MUSKRAT OPENS THE UNIO.

BY W. S. LEE.

Almost every person, if he has passed along the banks of ponds or brooks, has seen the channels of the muskrat (*Fiber Zibethicus* L.), and observed at the openings shells of the fresh-water mussel (*Unio*). If these have been picked up and examined closely, the observer has seen that they have all been opened and the animal extracted, or that they had died and the animal rotted out. The last is out of the question, for it is impossible that the mussels would all go to certain places to die. The fact is, they were opened by the muskrat, but this was not known to me until a few months ago, when I had the satisfaction of seeing the operation performed. I saw a muskrat swimming down the stream, and as it was unusual to see the creature in the daytime, I stopped to look at him, and after a few minutes I saw him dive down and over a mussel lying on the bottom and insert his claws into the shell from the under side, completely encircling the shell. The muskrat then swam to the shore, proceeded to pull the valves apart and devour the contents. Since then I have taken the living mussel shells and tried to separate them, but found myself unable to do so. The ease with which the muskrat did it leads me to think that when the claws were inserted they must have struck some vital part and thus deprived the mollusk of the power to close its shell; otherwise the shell would probably have been broken, but close examination failed to show a fracture or any marks whatever.

A FEW WILD FLOWERS UNDER CULTIVATION.

BY ERNST VOLK.

Among the most beautiful wild flowers growing around Trenton are two species of the great lily family, which, as Linnæus says, have no poor relations. These are *Lilium Canadense* L., and *L. superbum* L., the noted bell-shaped Canadian and the brilliant Turk's cap lily. They have long been known and admired. Parkinson described them as early as 1629, but seldom are they cultivated, as they deserve to be, for once established they take care of themselves and steadily increase.

Lilium Canadense blooms about the middle of June. It has a bell-shaped, canary-yellow flower, varying to coral red. The thick, scaly bulb is annual, and scarcely half an inch long, although it sends out runners five or six inches in length. In shaded places it is only about two inches under ground, but in sunny spots four to five. The lily will travel slowly, as the runners produce new bulbs in every direction. I have found, in a space eighteen inches square, five stems, the bulbs being connected by the runners. In sunny places the stems grow to a height of one and a half to two feet; among bushes and on the borders of woods, to six feet. In a single instance I found a stem nine feet eight inches high, with fourteen flowers in full bloom. In the sun the flowers are seldom more than three on one stem, but their color is then brilliant. In the shade the blossoms may be ten or fifteen, but the color is usually dull.

Lilium superbum has bulbs so closely resembling those of *L. Canadense* that a good judge would be needed to distinguish them, but they are perennial. The stems vary from six to ten or twelve feet in height. The flower buds are round, those of *L. Canadense* being triangular. This lily prefers a bushy place, so that the stem may be somewhat shaded. Four years ago I planted six bulbs of *L. superbum* in my garden, and the stems

have each year averaged a height of ten to twelve feet, with fifteen to twenty flowers in a cluster.

Either of these lilies may be successfully transplanted while in bloom, by cutting off the stem about two inches above the bulb, the new stems appearing the following spring. Once planted, they need no further care. They steadily increase, and their exquisite bloom soon illuminates the whole garden.

Chrysopsis Mariana Nutt., with its golden stars; *Lobelia cardinalis* L.; the waxy-white *Chelone glabra* L.; the deep blue *Gentiana Andrewsii* Griseb., and the bright-yellow *Helenium autumnale* L., are all fit for cultivation.

Lobelia cardinalis L., needs no protection in the winter, as I accidentally proved by unintentionally omitting to cover some of my plants, which re-appeared in the spring, while the protected ones all died. The wild lobelia can be obtained and cultivated by root or seed. If the roots are taken, remove as much earth with them as possible, after cutting off all the stems. Young plants thrive best. They should not be planted deeper than found. Before the winter sets in they become established. The seeds ripen by the middle of October. Plants raised from the seed will not flower the first season.

Chrysopsis Mariana Nutt., is a charming golden-yellow, aster-like flower, growing in dry weeds and half-shade. Dr. Thomas Dale, in 1742, took it to England, where it met with admiration from the start. It is a dainty little gem of a flower; everything about it is neat and fine. It remains in bloom for fully ten weeks, and is easily cultivated from root or seed.

Helenium autumnale L., is a showy plant, growing luxuriantly in damp places, and blooming profusely through September and October. It is also readily cultivated from seed or root. Its height will be less in a dry place, but the yellow color of the petals will be rather brighter.

Gentiana Andrewsii Griseb., is raised in the garden with great ease, demanding no attention. I planted the bare root, which I pulled up without any soil attached. It sprouted the

next spring, and has bloomed every September since, increasing steadily, producing ten to twelve stalks from one bunch of roots. The flowers are a beautiful shade of blue, striped on the inside with white.

Chelone glabra L., is hardy and robust. The peculiar, creamy-white flowers, which in form resemble the head of a turtle, bloom in four rows, crowning the summit of the tall stem. The roots may be taken in the autumn. They prefer a somewhat rich soil mixed with sand.

Many of the Solidago genus would repay cultivation. Their brilliant bloom would be an ornament to any garden. For the last ten years *Solidago puberula* Nutt., has grown and bloomed splendidly in a neighbor's yard.

The beautiful *Gerardia purpurea* L., has disappointed me. I have tried many plans of cultivation, but all have failed. The plant will not appear the second year after transplanting, either from the root or seed. This is probably due to its partially parasitic habits. The first season it blooms finely, and then dies. It is worthy of further experimentation, as the large bell-shaped, purple flowers would be an attraction in any collection.

I have been able to refer to but few of our wild flowers in this connection. There are, however, many that would repay a little attention, and surpass some of the high-named and high-priced tropical importations.

NOTONECTA UNDULATA SAY, AN ENEMY OF THE GOLD FISH.

BY DR. T. S. STEVENS.

In the spring of 1884 I had a small globe containing two vigorous, healthy gold-fish (*Carassius auratus* (L.) Bleeker). Into this I dropped a water-boatman (*Notonecta undulata* Say), a little fellow not much more than half an inch in length, but,

as the sequel will show, not only do these predacious little insects prey upon other aquatic insects, but under certain circumstances they will attack larger game, and may be a source of annoyance and death to the fish in the ponds where they abound. In a day or two after I had placed the *notonecta* in the globe I found one of the fish dead, which I removed, thinking it had died from natural causes. A few days later I found the other fish dead, with the *notonecta* clinging to it near the gills, evidently sucking its juices. I lifted the fish from the water, with the insect still clinging to it. The *notonecta* not releasing its hold when I gave the fish a vigorous shake, I attempted to remove it with my fingers. No sooner had I broken its hold on the fish than it drove its sharp beak into my finger. The pain was sharp, like the sting of a bee, but soon passed away. I then felt convinced that my gold-fish had been the victim of the little *notonecta*, and to test the matter, after subjecting it to a week's fasting, I placed in the globe with it another vigorous gold-fish, and watched the result. In the course of half an hour the insect had fastened itself on the fish near the gills, causing it to dash around the globe in evident pain and distress. I was here called away from my watch, but on returning in about an hour I found the fish swimming slowly on its side, apparently dying. I lifted it from the water, the *notonecta* still clinging to it. After removing its tormentor, taking care not to use my fingers, I replaced the fish in the water, where it soon regained its vigor, and lived for months after. Whether it is the habit of this insect to prey on and destroy small fish when at large, I do not know, but I have no doubt both as to its inclination and ability to do so when in confinement, and removed from other prey.

DOUBLE COCOONS OF ATTACUS CYNTHIA (DRU.) L.

BY GEORGE PINE.

A writer in *Science Gossip* has recently called attention to the formation of double cocoons by the silk-worm, stating that it is quite a common occurrence, while another correspondent, on the authority of an informant, writes that the silk had been successfully removed from a similar cocoon; "consequently," he says, "I should judge that only one worm did the spinning, the other remaining dormant meanwhile." Such formations are not, so far as I am aware, a usual occurrence among our common moths and butterflies. In no cocoon of any of the class have I observed an instance of so interesting a freak, except in that of the ailanthus moth (*Attacus cynthia* (Dru.) L.), where it would seem to be quite as common as with the silk-worm, three double cocoons of *Attacus* having come to my notice within a short time.

In each of these cases the cocoon was nearly twice the width of the ordinary single formation, and, with two exceptions, resembled the usual silk-covered case, these differences being the two pupæ within, and the thin partition, not more than a quarter of an inch long, at the anterior end. The two pupæ were perfect, lying side by side, and in contact with each other.

One of the three specimens obtained is still under observation; the second was partially eaten by a mouse, and the pupæ destroyed, but the third was successfully reared with a result as interesting as it was unexpected, a perfect male and female issuing from the double envelope.

I learn from Mr. John Akhurst, of Brooklyn, that he has also met with several instances of the kind among *Attacus cynthia*. The occurrence is therefore probably not rare with this moth. It is, however, of sufficient interest and importance to be recorded, which, so far as I have ascertained, has not been previously done.

HIBERNATION OF REPTILES.

BY F. A. LUCAS.

When nature decorates the trees for their burial, and the songsters take their departure, when the brown nuts play a tattoo on the ground, and the nimble squirrel garners them for future enjoyment, and when the sportsmen begin their assault on the furred and feathered game, then are we admonished that the summer is over, and it behooves us to prepare for winter's cold embrace.

While making provision for our own comfort and protection, it is but natural that we give a moment's thought to the welfare of the lower creatures, and inquire how they spend the time during the freezing weather of our northern winter. Such meditations lead to investigations; and the result of these constitutes the subject of this article. We confine ourselves to the consideration of the hibernation of reptiles.

Hibernation is a kind provision of nature, enabling certain cold-blooded animals to pass through the severe cold of winter in a pleasant state of torpidity or insensibility. This torpidity is a happy substitute for sure starvation and death. Though some mammals or warm-blooded creatures sleep through the cold season, yet hibernation is especially beneficial to the lower classes, as the reptiles, batrachians, &c.

The food of the reptiles is so scarce, indeed it is entirely wanting in the cold weather, that starvation is almost certain; so to sleep the winter through is an agreeable way of escape from sure death. The natural food of the frogs, toads and other batrachians consists mainly of insects. The principal food of snakes is furnished by the frogs, toads and small mammals. Now the cold weather kills, or compels to fly away, the insect food of the batrachians, and thus they are, from necessity, driven to accept the only alternative offered between death and

protracted sleep. The snake cannot procure its natural nourishment at this season, so it seeks relief from cares and suffering in balmy sleep. Starvation, however, is not the only cause for hibernation of reptiles. These animals may exist a long time without food, but, being cold-blooded, and possessing little animal heat, it is to escape the freezing cold that they "go into winter quarters."

Though hibernation is not a strict necessity, or a rigid law of nature, for domestication removes the need and the subject lives in comfort through the severest weather, yet there appears to exist a peculiar and requisite preparation for this prolonged death-like slumber. We know, from experiment, that reptiles confined in warm quarters till the earth is frost-bound, and King Winter reigns supreme, and then put "out in the cold," will perish sooner that non-hibernating animals. Again, if reptiles are suddenly aroused from their almost lifeless sleep, death ensues, or if an unusually severe "snap" occurs they freeze to death. It is said that during hibernation the respiration and the digestion of reptiles are suspended.

We are not aware that reptiles hold any peculiar preferences for place and condition, in which to hibernate. In our quiet rambles in early spring, we have surprised these creatures just awaking from their Rip Van Winkle lethargy, in various situations and conditions. We have found snakes coiled under flat stones, pieces of tin, carpet and other refuse; we have seen them ploughed up; we have scorched them out of hiding-places in banks, stone walls, under roots of trees and other retreats. We have found water-adders (*Tropidonotus sipedon* (L.) Holbr.) coiled beneath small stones along the river's banks, or covered with decayed vegetable matter, and snugly concealed from casual glances among aquatic plants on the borders of stagnant pools. We have secured garter-snakes (*Eutœnia sirtalis* (L.) B. & G.) and the variety (*E. ordinata* (L.) Cope) cozily ensconced beneath old logs and similar places. Sometimes we have met a colony of snakes made up of several members of different genera, so

entwined and twisted into a compact mass as to make it a difficult task to distinguish individuals.

Frogs congregate in masses, and pass the winter in the beds and banks of their native haunts. We have found plump specimens of the common toad (*Bufo lentiginosus* Shaw) squatted in a slight depression under a plank; and we have unearthed colonies of little fellows a foot or so beneath the surface.

The lizards hibernate under decayed leaves; and the newts and salamanders pass the winter beneath stones on the banks of streams. The testimony of a friend is that he saw a "lizard dug up from five feet below ground."

The box-turtle (*Cistudo Carolina* L.) buries itself a foot or so beneath the surface, and weathers the cold blasts of winter tightly housed in his closely-fitting shell. The pond-turtles hibernate in the beds and banks of streams. Thus all sleep, serenely indifferent to the hard experiences of the higher animals during merciless winter.

SOME OF NATURE'S REGULATORS.

BY WILLARD A. STOWELL.

Most insects are so prolific that were it not for the restraining influence which nature exercises over their increase the earth would soon become a barren and uninhabitable waste. Many produce thousands, or even millions, of eggs during the year; while the progeny of an Aphis number, in a single season, about a trillion. Almost every insect has its enemies. Some fall a prey to foes in the vegetable world; but the larger part, by far, are destroyed by parasites or perish in the eternal struggle for existence. Certain plants attract insects only to destroy them by their poisonous juices or noxious exhalations; while carnivorous plants, as *Dionœa* and *Drosera*, hold their victims until

dissolved in fluids secreted by the plants. Birds exert a great controlling influence over the increase of insect life. Who has not seen the robin searching the grass for his breakfast of worms and caterpillars, or the woodpecker busily rapping and tapping some worm-eaten tree for the grub which he knows is hidden there?

In the limited space of an article like this, the mere mention of some of the principal restraining causes must suffice. Those enemies whose influence hold in check the prolific family of insects, of which we wish to speak more particularly, are to be found among themselves—insect preying upon insect. The *Libellula* skims over the surface of the pond, and woe to any fly or mosquito that comes in range of its sharp eyes. The larva of the *Coccinella* subsists entirely upon plant-lice, which it destroys in great numbers; and the tiger-beetles are so rapacious that they have been known to destroy grubs and perfect insects of their own species. The ichneumon family, of which it is estimated there are over three thousand species in Europe alone, prey more particularly upon the *Lepidoptera*. Their method of attack is entirely different from any we have yet considered, although none the less effectual. They deposit their eggs in the soft body of the caterpillar, where their larvæ live until fully grown, subsisting upon the juices of the caterpillar and carefully avoiding any vital part. After having attained their growth they pierce the skin which confines them, covering it with little silken cocoons; or, perhaps, waiting until the caterpillar itself has entered the pupa state, they come forth in the spring instead of the expected moth or butterfly. Some species of ichneumons (*Pimpla*) have a long ovipositor, which they insert, from three to four inches, into a tree and there deposit an egg in the body of some wood-grub. Sometimes, indeed, these bold destroyers are unable to extricate the ovipositor and so remain fastened to the tree until they perish from exposure. In a tree much frequented by the long-tailed ichneumon, the writer has found pieces of ovipositors firmly imbedded in the

wood; and on one occasion obtained a fine specimen whose ovipositor had penetrated to such a depth that the *Pimpla* was easily secured before it could escape. Thus the family of insects, a prey to foes without and within, are held in check, where otherwise they would soon render our globe a dwelling unfit for man or beast.

NOTES ON PERIDINIUM AND OTHER INFUSORIA.

BY DR. ALFRED C. STOKES.

Since Ehrenberg, in 1836, wrote of the loricate animalcule which we now know under the name of *Peridinium*, and Claparede and Lachmann, in 1858, instituted the order cilio-flagellata for the reception of the single family group of the Peridiniidæ, the infusorian has been described by all writers on the subject as possessing a single flagellum extending along the longitudinal depression on the cuirass, and with a girdle of rapidly vibrating cilia clothing the groove that transversely encircles the body. That the ciliary girdle has only recently been proved to be an optical illusion is no discredit to the observers of the past, for with insufficient amplification, or under any but a modern first-class objective, the appearance is wonderfully like that of ciliary action, but is in reality due to the rapid vibrations of a flagellum. *Peridinium* has therefore two flagella and no cilia. That this was not noticed long ago is rather a compliment than otherwise to the original describer of the genus, since his observations have been accepted by all workers in the same department as accurate without question.

The rather startling discovery that there are no cilia in the transverse groove was recently announced by Klebs, and subsequently confirmed by Bütschli. I have not yet had access to their papers, and therefore do not know the exact particulars

which they may present in reference to the appearance, arrangement and characteristic movements of the transverse flagellum. Observations, however, that I have had the opportunity to make on a species of *Peridinium*, which I have identified as a variety of the variable *P. tabulatum* (Ehr.) S. K., have confirmed the statements of the German naturalists, although they needed no other confirmation than Bütschli's simple assertion. Yet it has afforded me much pleasure to satisfy myself by direct examination and actual sight, that the flagellum in the transverse groove of *Peridinium* is a reality.

In the species here referred to, the transversely-directed appendage can be studied with comparative ease by means of a Spencer homogeneous immersion one-tenth inch objective, after the infusorian has been weakened by prolonged confinement beneath the cover-glass, and the movements of the flagellum have therefore become less rapid than in health. It then presents the aspect of a long spiral coil lying in the depression, rotating on its longitudinal axis, and extending around the body from the right-hand side of the longitudinal groove toward the left-hand side for about three-fourths of the entire circumference of the infusorian. Among the numerous specimens examined I have been unable to obtain one in which the spiral flagellum made the entire circuit of the body and appeared on the left-hand side of the ventral portion of the transverse groove.

The apical extremity of *Peridinium* has always, so far as I am aware, been considered the frontal border. The longitudinal sulcus ends there after originating near the centre of the ventral surface, and the flagellum lying within it extends beyond the margin at the apical termination of the groove. *Peridinium tabulatum*, then, always swims backward, for the terminal portion of the longitudinal groove is always at the rear of the infusorian when swimming, and the longitudinal flagellum always trails beyond the apical extremity.

A similar condition in reference to the transverse groove is said to prevail in *Ceratium*. This I have not had an opportunity

to observe, although Mr. A. H. Breckenfield has very kindly endeavored to send me a quantity of *C. hirundinella* (Mull.) Bergh, from the water supply of San Francisco, where the infusorian abounds in great profusion, but none survived the long journey. The two genera, *Ceratium* and *Peridinium*, are so closely allied that, aside from the statement of Klebs and Bütschli, there can be no doubt as to the absence of the so-called ciliary girdle, and the presence of a transversely-directed flagellum. It would be of great interest, to the writer at least, to know whether that appendage in *Ceratium* presents the coiled aspect so conspicuous within the encircling groove of *Peridinium tabulatum*.

It is not often possible to make one's observations of individual infusoria even partially complete. Many points of interest and importance are necessarily left for investigation at some future time, which is often indefinitely postponed, since the forms desired cannot always be readily attained, even in the habitats most favored. Because a special infusorian may swarm in a certain place at a certain time is no proof that it will long continue, but rather that it will soon disappear. The observer must therefore seize the favorable moment, take what he can get, be thankful for that, and content to allow his reports to appear fragmentary and disjointed. The following notes on previously observed forms are presented in order to make previous reports somewhat more complete than was possible when first published.

Vorticella smaragdina, *V. utriculus* and *V. macrocaulis* (*Am. Nat.*, xix., Jan., 1885, p. 21), originally described from western New York, also occur in the cedar swamps of the New Jersey pine barrens, where the pedicle of *V. utriculus* is often four times as long as the body, instead of three times, as stated in my description.

Loxodes rostrum Ehr. is reproduced by transverse, somewhat oblique, fission. *Spirostomum teres* C. and L. Conjugation takes place by union of the entire length of the peristome field. Reproduction is by transverse fission.

Stichotricha secunda Perty. The granular condition of the mucilaginous sheath is caused by the infusorian's excrement, the anal aperture, which has not previously been observed, being situated near the posterior extremity. The animalcule darts forward until the opening is at the anterior margin of the sheath, to which the excrementitious particles adhere.

Chilodon caudatus (*Am. Jour. Sci.*, xxix., April 1885, p. 326) reproduces itself by transverse fission, the peculiar anterior lip being formed on the posterior moiety after the complete separation of the two zooids.

Stylonychia mytilus Ehr. The variety with fimbriated styles is not uncommon in the writer's vicinity.

Dexiotricha plagia (*Am. Jour. Sci.*, xxix., April, 1885, p. 327.) Conjugation takes place through the union of the anterior ventral surfaces, and apparently includes the oral aperture.

In the *Proceedings of the American Society of Microscopists*, third annual meeting, 1880, p. 44, under the title, "Notes on the Structure, Development and Position of an undescribed Flagellate Infusorian," Mr. J. H. Fisher describes, with the provisional name, *Laguncula*, a new genus of fresh-water infusoria, which is made to include two species, *L. piscatoris* and *L. Kellicottiana*, the latter differing from the first-mentioned only in the constant and conspicuous presence of a pigment spot, a character of no diagnostic value. A form corresponding in all essential features with those referred to by Mr. Fisher occurs sparingly in the writer's locality, and is undoubtedly a member of the genus *Trachelomonas*, to which the infusoria observed by Mr. Fisher also evidently belongs, and to which they are here relegated. The species may be described as follows:

Trachelomonas piscatoris Fisher sp. (*Laguncula piscatoris* Fisher; *Laguncula Kellicottiana* Fisher.) Lorica flask-shaped, cylindrical, less than twice as long as broad, the surface clothed by numerous short, conical spines; both extremities equally rounded, the anterior aperture produced into a smooth, cylindrical, neck-like prolongation, about one-seventh the entire length of the

lorica, the frontal border denticulate and often bearing a row of short, conical spines similar to those on the general surface; flagellum once and one-half to twice as long as the lorica; endoplasm usually granular; contractile vesicle and nucleus not observed. Length of lorica, $^1/_{640}$ to $^1/_{1000}$ inch. Habitat, fresh water.

In the interesting paper alluded to, Mr. Fisher states that: "On testing with solution of potash or soda * * * the spines are detached from their basis, whilst the lorica remains unaffected, either in form or rigidity. Thus the probability is established that these spines, again like those of the echinodermata, are articulated to the lorica by an organized membrane which yields to the action of the salt, and the separation is effected. On testing with hydrochloric acid, brisk effervescence immediately takes place; the main body of the lorica is dissolved. * * * The chief constituent of the lorica is, therefore, shown to be calcareous." Although I have carefully repeated these experiments, the results have been different from those detailed by Mr. Fisher. With a larger amount of material at my disposal, however, it may be possible to confirm his observations.